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Bulletin No. 19

UNION OF SOUTH AFRICA

DEPARTMENT OF MINES

FLUVIAL
ANDALUSITE DEPOSITS
IN THE
MARICO DISTRICT

BY

D. P. VAN ROOYEN, B.Sc.

(Translated from the original Afrikaans by the Translation Bureau)

Publication of the Geological Survey Division

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FLUVIAL ANDALUSITE DEPOSITS IN THE MARICO DISTRICT

ABSTRACT

Large quantities of andalusite are concentrated in some spruits in the Marico district. The natural processes responsible for the deposition of andalusite sand are treated briefly. The method of sampling and the determination of the content of the andalusite in each occurrence are discussed. All results are summarised in a single table at the conclusion of this bulletin. Two maps indicating the concentration of the andalusite sand in the spruits and the geology of the environment are included.

I.—INTRODUCTION

The most important occurrences of andalusite are near the railway line between Johannesburg and Mafeking. The area in which andalusite concentrations occur has as its boundaries the Great Marico river to the east, the railway to the south, and the Little Marico river to the west and north. The Doorn river occurrence lies due west of this area.

The occurrence of andalusite as a constituent of metamorphic rocks was observed at the time of the earliest geological surveys carried out by Hall and others in the Marico district. They do not, however, mention the large quantity of andalusite sand occurring in the spruits to the west of Groot-Marico. During 1934 Partridge (^{1}) received and examined a few samples of these sands. Since then interest in the material has been revived and further experiments on the sand were carried out by the Government Metallurgical Laboratory, the results of which were published (^{2}) in 1939. The research proved that the andalusite is sufficiently pure to be used as a refractory and that it would be possible to obtain a relatively pure product.

II.—PHYSIOGRAPHY

The topography of the area is characterised by the unsymmetrical valleys usually associated with the Pretoria series, which underlies them. The southern sides of the valleys are built from the dip slopes of the beds and the steep northern slopes from the escarpment face of the ridges. In this area the Ongeluk lavas also form a ridge which is, in places, better developed than that formed from the Daspoort quartzites. Subsequent to the formation of the ridges a new period of erosion probably set in, as a relatively large isolated hill on Magozastad 279 is a relict of an earlier continuous ridge. The rocky crown of the hill consists of Ongeluk lavas.

The Great Marico river is the most important drainage channel of this area (see fig. 1). The river has its source on Grootfontein 92, on the contact of the dolomite and the lower shales of the Pretoria series, and flows in a northerly direction.

DRAINAGE LINES WEST OF GROOT-MARICO

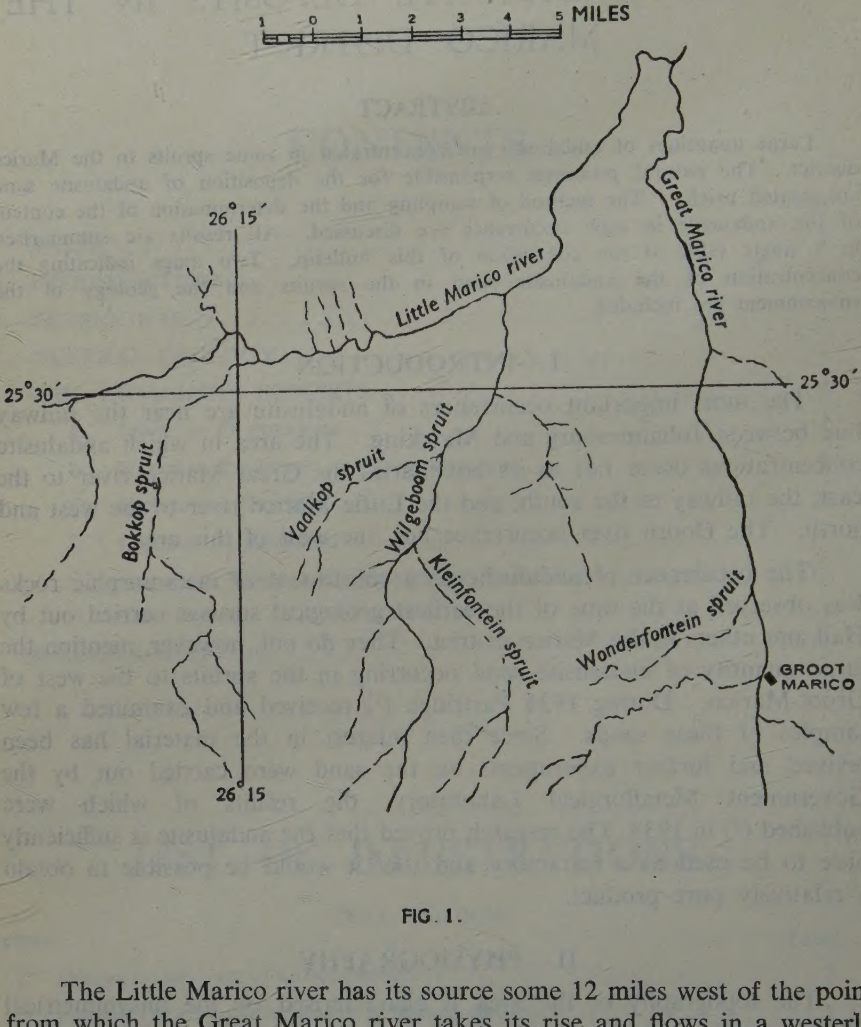


FIG. 1.

The Little Marico river has its source some 12 miles west of the point from which the Great Marico river takes its rise and flows in a westerly direction to Zeerust and from there E.N.E. until it joins the Great Marico river.

The Wilgeboom spruit flows in the direction of the dip of the Pretoria series and follows a winding course in a comparatively extensive silt deposit on Wilgeboomspruit 278, Magozastad 279 and Welverdiend 48.

On the latter farm the spruit joins the Little Marico river. The smaller drainage system of the Wilgeboom spruit is of importance since the andalusite is mainly concentrated in the beds of the courses belonging to this system. The Wilgeboom spruit is fed by the Kleinfontein spruit and the Vaalkop spruit as well as by numerous dongas.

III.—GENERAL GEOLOGY

The area containing the andalusite concentrations is entirely occupied by rocks of the Pretoria series. Only brief reference to this is made in the discussion which follows. North of this area the intrusive rocks of the Bushveld igneous complex are present and to the south the country is underlain by the Dolomite series. The occurrence of the following are therefore significant in the vicinity of the river courses containing concentrations of andalusite:—

1. rocks of the Pretoria series; and
2. Recent silt deposits.

1. ROCKS OF THE PRETORIA SERIES

Particular attention is paid to the shale bed between the Timeball Hill quartzites and the Ongeluk lavas, as, in the area under discussion, the andalusite is for the greater part contained within this stratum from which consequently most of the andalusite crystals originate to be concentrated in the river courses. The shales are of a bluish-gray colour, which is held to be due to the presence of small amounts of carbon. In contrast to this, the shales below the Timeball Hill quartzites are of a brownish colour, caused by the presence of iron oxides.

Towards the middle of the above-mentioned shale bed there are persistent outcrops of diabase. These lie on a single horizon throughout, so that they may all be taken as representing one sheet. The diabase can be traced from Brakfontein 278 in the east to Palmietfontein 70 in the west. Apart from this diabase smaller intrusions, exposed by erosion in the spruits, are present. The smaller intrusions seldom exceed 3 to 4 feet in thickness. They led to localised folding of the shales, which may be observed at various points in the banks of the spruits e.g. in the Wonderfontein spruit and the Vaalkop spruit.

The Lower Ongeluk quartzite is well developed and can be traced almost continuously as it is only very occasionally missing. This quartzite bed is rarely more than 3 feet in width.

The metamorphic origin of the andalusite is not discussed at any great length here, as it has hardly any bearing on the purpose of this bulletin and as a very much greater area would have to be mapped in order to do justice to the problem. According to Hall (³) it is clear, however, that the aureole of metamorphism of the Bushveld complex varies considerably in width from place to place in accordance with the extent to which the various beds have been affected.

In the Marico district we are concerned mainly with the alterations produced by the gabbro of the lopolith. The rocks which have been affected consist of quartzites, carbonaceous and ferruginous shales, Ongeluk lavas and dolomites. The area affected by the metamorphic influences of the igneous complex gradually increases in extent in a westerly direction from Pretoria until at Zeerust, some 140 miles distant, the entire thickness of the Pretoria series and even the upper horizons of the Dolomite series have been affected. To the west of the Crocodile river the andalusite is found as a product of metamorphism even in the Magaliesberg shales. In hand specimens andalusite is, however, observed only sporadically. From Scheerpoort through Swartruggens to Lindleyspoort there is a sharp and marked increase in the width of the aureole, and the strata underlying the Daspoort quartzites are also affected. South of Rustenburg andalusite in graphitic shales is encountered above the Daspoort quartzites.

From the Elands river westward the metamorphism has advanced through the Pretoria series to its lower horizons, the shales immediately above the Timeball Hill quartzites also having become andalusite-bearing. To the west of the Great Marico river the Magaliesberg shales overlying the Daspoort quartzites have been altered into a crystalline hornfels. North of Zeerust the shales underlying the Timeball Hill quartzites are also andalusite-bearing. Two metamorphic zones are known to exist, an inner zone of intense metamorphism and an outer zone where only thermal metamorphic minerals are present and the rocks generally retain their original characteristics. There is no sharp contact between the two zones, although the rocks belonging to each zone are clearly distinguishable from those of the other zone. A metamorphic rock from the western area could, however, easily be ascribed to either of the two zones. Crystalline hornfels is regarded as belonging to the inner zone, whereas andalusite-bearing shales are associated with the outer zone. It may happen, however, that a mineral such as cordierite, which is characteristic of the inner zone, may be encountered in the outer zone. On the other hand andalusite and chiastolite, which are characteristic of the outer zone, seldom occur in the inner zone.

The causes of the varying thickness of the aureole of metamorphism of the Bushveld igneous complex are not quite clear. Kupferburger ([4] *p.* 54) suggests that southward there may possibly be a hidden extension of the Bushveld intrusion.

2. RECENT SILT DEPOSITS

Relatively large deposits of silt were formed in the area lying east and west of the Great Marico river. These deposits have a continuous basal pebble bed consisting preponderatingly of quartz and pebbles of quartzite with subordinate dolomite, chert, Bevet's conglomerate and fragments of shale. The pebble bed is followed by a thin band of silt which in turn is overlain by a thin layer of andalusite-rich sand, approximately a foot thick. The layer of andalusite sand is followed by silt to a depth of almost 25 feet in places. The silt in itself contains a minimum of andalusite. A very small percentage of the fluvial andalusite deposits in the spruits is, therefore, derived from the silt.

As the main streams of the area carved their channels deeper a new cycle of erosion was started, and the floor on which the silt was deposited is exposed in the present spruits. Soil erosion takes place at present and the silt has been carved into fantastic shapes. In the Wonderfontein spruit north of the Groot-Marico village the soil erosion resulted in a typical donga topography. The eroded area is littered with nodules of surface limestone. As the number of dongas spread over a widening area, andalusite was increasingly transported to the main streams. The most important Recent deposit is therefore the andalusite-rich sand.

IV.—THE ANDALUSITE DEPOSITS

A. MODE OF OCCURRENCE

The andalusite crystals are liberated from the parent shales by weathering and are carried by the floodwater from the hillls to the more level surface of the silt deposits where they are distributed. Should strong winds blow over the area, the finer dust particles and other lighter material are removed and a relatively pure andalusite sand is left. The material is then transported by further floodwaters to the spruits, where fluvial deposits are formed.

B. NATURAL PROCESSES OF CONCENTRATION

It may be accepted that the following factors influence the concentration of andalusite:—

(i) variations of temperature,
(ii) rainfall,
(iii) vegetation,
(iv) grade of the stream bed, and
(v) force of the current.

(i) *Variations of temperature*—The climate of the Marico district is almost typically continental, with a daily temperature ranging through approximately 30° F. Apparently the coefficient of expansion of andalusite is lower than that of the parent shale, which consequently breaks away and separates from the crystals.

(ii) *Rainfall*—Unfortunately there are no reports available regarding the intensity of downpours in this area, but the rainfall reports from 1933 to 1938 (fig. 2) clearly show that during the same season several precipitations exceeding an inch in the space of 24 hours were recorded. The heavier the downpour, the more easily is andalusite transported to the stream beds.

(iii) *Vegetation*—Where the catchment area of spruits is sparsely covered by vegetation, the chances are that greater amounts of andalusite would be washed down to the stream beds. The surface of the silt deposits is in places almost completely bare, so that wherever an isolated tuft of grass or aloe appears there is almost sure to be a concentration of andalusite-bearing sand. Andalusite has been found to be less heavily concentrated in grass-covered localities and particularly so in the Doorn river area.

(iv) *Grade of the stream bed*—The more steeply the river bed is graded, the more limited will the amount of andalusite deposited be. Along such more steeply graded parts of the beds mainly boulders of andesite, quartzite and shale fragments are encountered, and in the spaces between these small accumulations of andalusite are found. Andalusite is deposited only along the level parts of the spruit bed, its deposition being affected also by the number of bends in the channel, as concentrations of andalusite sand are consistently encountered along the fill sides of each bend. It is common knowledge that the speed of a current decreases along the inside of the bend, causing part of the material carried in suspension to be released and deposited there.

(v) *Force of the current*—The force of a current is affected by the heaviness of the rainfall as well as by the grade of the stream bed. A heavy downpour must of necessity facilitate the transport of andalusite towards the spruits. The force of the current also varies in accordance with the nature of the spruit bed. Wherever obstructions, whether artificial or natural, occur in the spruits, the stream is retarded and deposition of material takes place. At some places where weirs have been built the dams are altogether silted up with andalusite sands. The artificial rapids formed by such weirs result in hardly any concentration of andalusite sands taking place immediately below the weir,

C. Individual Deposits

(*a*) *Kleinfontein spruit*

The Kleinfontein spruit flows through Kleinfontein 76, and conditions for the transport of andalusite to the spruit are very favourable. Where the spruit approaches the boundary of Goedgelegen 285 it is not confined to a definite channel but floods an area covered with grass (see pl. I). By means of prospecting trenches an old bed of the spruit in which a layer of andalusite sand was still present was located here. The silting up of the spruit bed was probably caused by natural barriers. The layer of silt covering the sand is from 3 to 5 feet thick. The quality of the andalusite exposed here appears to be fairly good, but it is doubtful whether it will be economic to remove the silt. The total length of the spruit is 4½ miles, and over approximately 20,000 feet of this distance andalusite-bearing sands occur. The andalusite content of the material concentrated in the spruit is estimated at 40 per cent.

(*b*) *Vaalkop spruit*

The Vaalkop spruit has its source on Vaalkop 66 and flows over Schietkraal 332, Magozastad 279 and Goedgelegen 285, where it joins the Wilgeboom spruit. As in the case of Kleinfontein spruit conditions here are favourable for the transport and accumulation of andalusite, excepting that the quantities of adalusite washed down from both sides of the spruit are greater and that along the upper course of the spruit there are more dongas feeding it. Andalusite sand occurs over a distance of 29,500 feet along the spruit. The spruit is one of the most promising prospects for exploitation, as 90 per cent. of the total length is accessible or could easily be made accessible.

(*c*) *Wilgeboom spruit above its junction with the Vaalkop spruit*

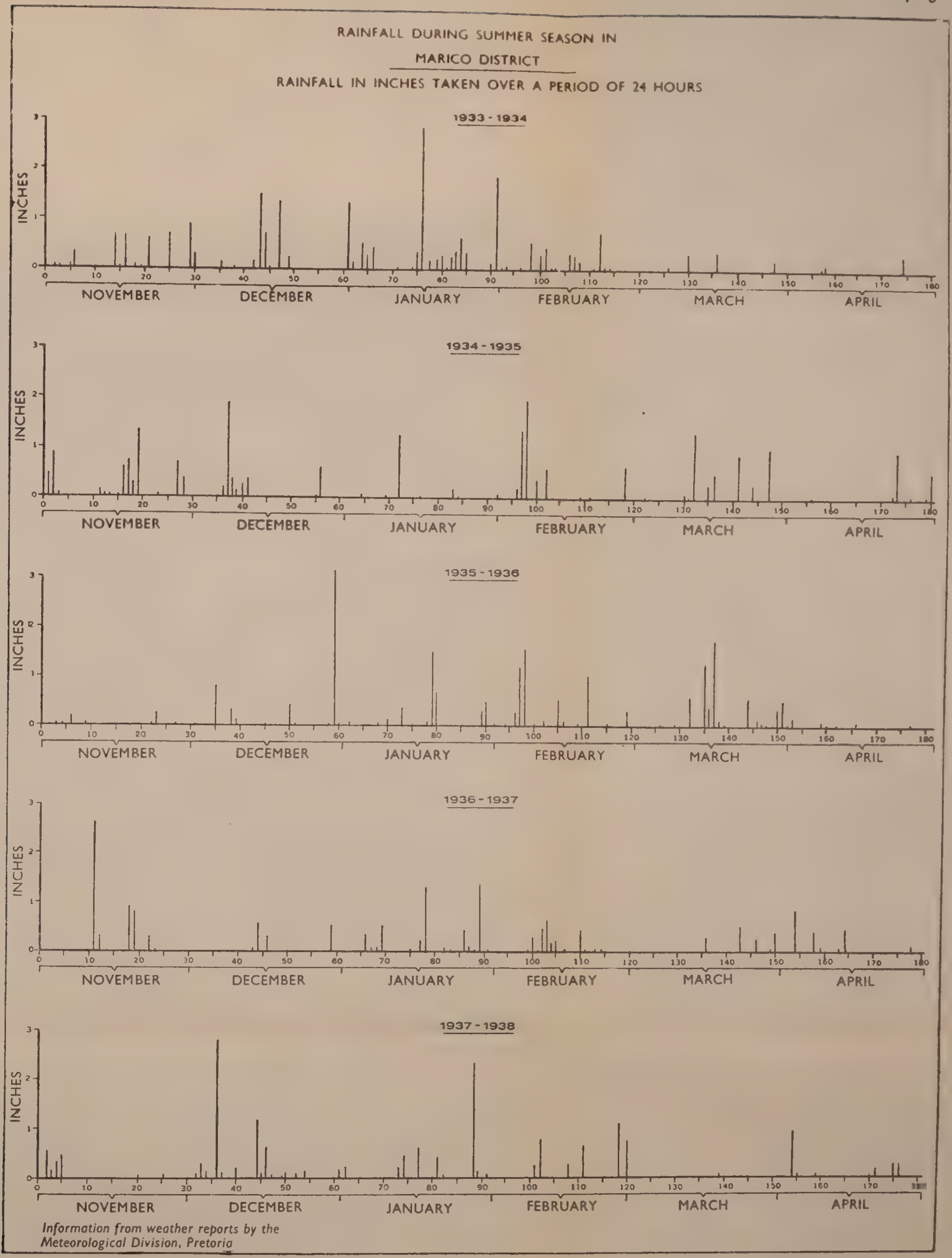
This part of the spruit, which flows over the Magozastad 279 and Goedgelegen 285 in a winding course, has two cut-off meanders, both filled up with silt. Below the layer of silt in the cut-off meanders andalusite is encountered. The thickness of the silt layer is about 7 feet. A dam which was built across the lowest cut-off meander is at present completely filled up with andalusite sand to a depth of almost 20 feet.

(*d*) *Wilgeboom spruit between the Vaalkop spruit and the Little Marico river*

In this part of the spruit andalusite concentrations occur alternately with strips covered with fragments of andesite and quartzite. In the past there were undoubtedly deep holes in the spruit bed, which is at present completely filled up with sand. The occupiers of farms along the banks state that some of the spruits used to reach a depth of 25 feet. In taking samples in the spruit it was at times extremely difficult to reach the floor. At the point where sample 20 was taken the digging was discontinued at a depth of 9 feet, as movement was observed in the sand.

(*e*) *The Little Marico river between the Wilgeboom spruit and the irrigation canal*

All the above-mentioned spruits serve as feeders for carrying andalusite to the Little Marico river. The river has a well-defined channel, the banks being approximately 20 feet high. This causes some difficulty in approaching the river bed, but this could be overcome without very great difficulty.



RAINFALL DURING SUMMER SEASON IN

MARICO DISTRICT

RAINFALL IN INCHES TAKEN OVER A PERIOD OF 24 HOURS

1933 - 1934

1934 - 1935

1935 - 1936

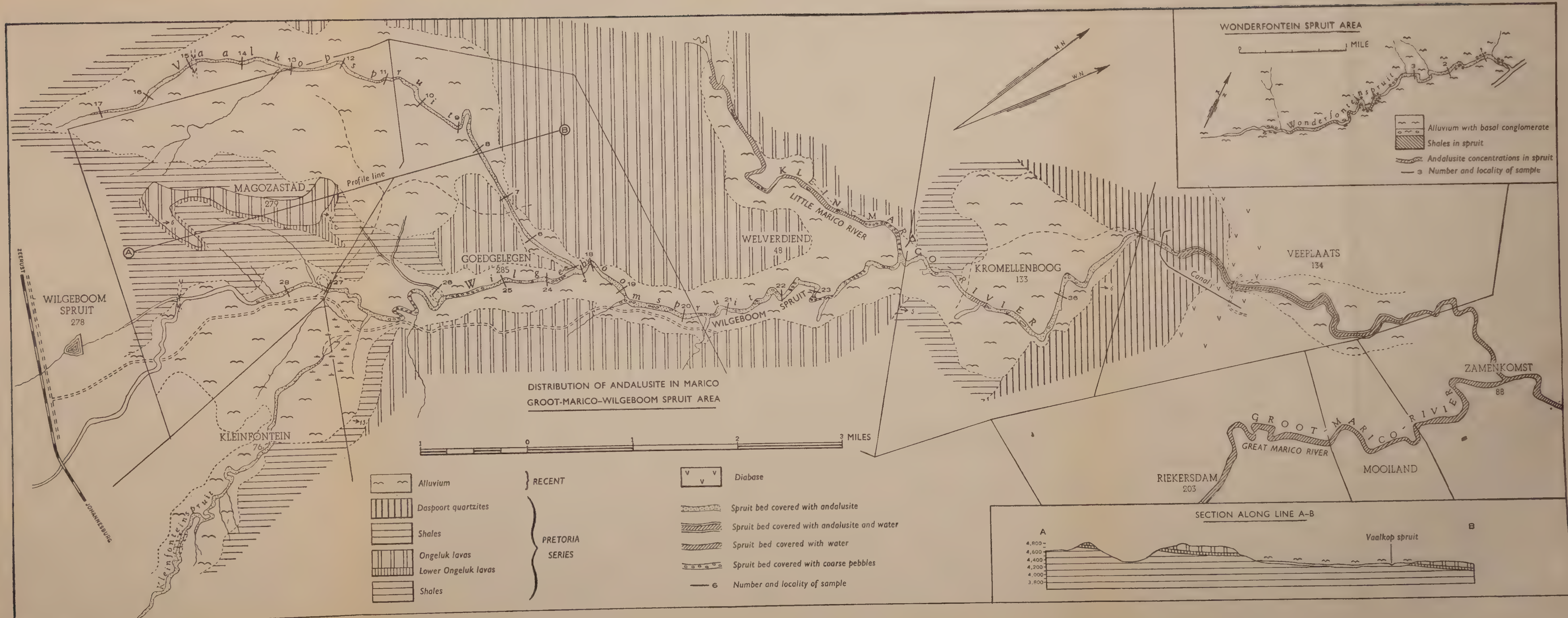
1936 - 1937

1937 - 1938

Information from weather reports by the Meteorological Division, Pretoria

FIG. 2.

PLATE I



DISTRIBUTION OF ANDALUSITE IN MARICO
GROOT-MARICO–WILGEBOOM SPRUIT AREA

Excepting during singularly dry seasons water is always found in the sand layer here. Owing to this it has not been possible to determine the actual thickness of the sand, but there need be no doubt that large concentrations of andalusite have been deposited here. The sand occurring in this locality is of good grade throughout, and the sample taken may be regarded as being generally representative.

(*f*) *The Little Marico river below the irrigation canal up to the Great Marico river*

On Veeplaas 134, approximately 1,000 feet from the boundary of Kromellenboog 133, the water canal from the Great Marico dam passes under the Little Marico river to the northern bank. As a result of possible seepage from the ducts there is a constant stream of water in this part of the river. Large concentrations of andalusite were deposited here, as in the case of the portion of the river between the Wilgeboom spruit and the irrigation canal, and owing to the water present it was not possible to take samples.

Immediately below the confluence of the Little Marico and the Great Marico rivers the stream was diverted and a weir was built, with the result that water pushes up into both rivers. The grade of the andalusite sand appears to be similar to that from the previously described locality.

(*g*) *Wonderfontein spruit*

The road to the Groot-Marico dam passes over the lower reaches of the spruit about 4 miles from the Groot-Marico post office. The spruit is the most important drainage canal in a relatively large eroded area. The transport of andalusite to the spruit is facilitated by a large number of dongas. The spruit is accessible over its entire length.

(*h*) *Doorn river*

The Doorn river (see fig. 3) which is in reality only a spruit, flows from west to east approximately along the contact of the Timeball Hill quartzites with the Upper Daspoort shales. Vegetation on both sides of the spruit impedes the washing away of sand. Along the southern feeder of the spruit mainly quartzite sand is found. Andalusite is washed down only from the northern bank. When quartzite sands are introduced the grade of the sands concentrated in the water courses is invariably reduced. Water coming from the quartzite sands constantly seeps into the spruit, so that it was not possible to determine the actual thickness of the sand deposit.

Only the stretch of the Doorn river falling between the Little Marico river and the road from Zeerust to Derdepoort is important as a carrier of ore. To the west of the road the stream bed is too steeply graded to allow of any deposition of andalusite.

D. METHOD OF SAMPLING

The spruits were all sampled individually. A prospecting trench was dug across the spruit. The width of the sand-covered spruit bed was measured accurately and marked off at intervals of 2 feet. At each mark ore was scraped down by means of a prospecting pick and the loosened material collected in a pan held at the lower end of the channel made by the pick. The thickness of the sand layer was measured at each mark and the average thickness of the particular prospecting trench calculated therefrom. The material obtained was thoroughly mixed on a canvas sheet and coned. The total sample was then repeatedly quartered until a sample of approximately a pound in weight was obtained.

The distances between the various trenches were determined and the method of sampling described above was repeated up to the edge of the andalusite occurrence in the spruit. The average width of the spruit was calculated according to the total number of strips measured, and the average thickness of the andalusite sand layer in the spruit was estimated from the total number of average thicknesses. The sample number on the map also indicates the locality from which it was taken.

In some parts, particularly along the lower reaches of the Little Marico river, it was not possible to determine the width, as there was too much water in this part of the river. The width was therefore estimated, and the figures may be taken to be on the conservative side. In the other cases, as for example in the Wilgeboom spruit, the digging of trenches was stopped before sand bottom was reached, as it became dangerous owing to movement in the sand. The thickness of the sand layer here was put at 9 feet.

A cut-off meander in the Wilgeboom spruit has been completely silted up and contains an andalusite sand layer 5 feet thick. The meander is some 600 feet in circumference and its width about 10 feet.

The samples taken in the field were dealt with separately in order to determine the andalusite content of the sands at the different localities. The method applied was the following. A portion of each sample weighing exactly 100 grams was measured off and was passed through 8, 14, 28 and 32 mesh screens. The plus fraction on each screening was weighed and its percentage determined. It was found that the ±8 and the −32 fractions are of very little enonomic importance. These fractions were not taken into account excepting where mentioned. The +32 fraction was in certain cases disregarded for the same reason.

Each fraction was treated with bromoform (S.G.=2·9). The light fraction consists of quartz, quartzite, andesite, shale and organic material. The heavy fraction consists mainly of andalusite and very small quantities of pyrolusite and magnetite, the latter of which were selected under a binocular microscope and removed. The pure andalusite was weighed. The percentage of recoverable andalusite in each sample was determined by adding together the weights of the various cleaned fractions.

In order to calculate the tonnage the grain size and the presence of impurities must be taken into consideration, as these cause considerable variation in the volume per ton of the sands *in situ*. In the calculation of tonnage a conservative average of 20 cubic feet per ton was therefore assumed.

E. GRADE OF SANDS AND QUALITY OF ANDALUSITE

With the exception of the Wonderfontein spruit and Doorn river the concentrations in all the spruits contain at least 50 per cent. of recoverable andalusite. The former two spruits contain 43 and 28 per cent. of recoverable andalusite respectively. The Wilgeboom spruit between the Vaalkop spruit and the Little Marico river carries the largest concentrations containing the highest percentage of recoverable andalusite.

In the majority of cases the andalusite contains a core of either iron oxide or carbon. The iron content of the crystals is higher than that of the famous Rocky Mountain material and cannot be used in the manufacture of, for instance, sparking plugs. Chemical analyses were made of some of the samples, and they all showed a theoretical value of more than 80 per cent. Al_2SiO_5. All chemical analyses were done by Dr. C. F. J. van der Walt of the Division of Chemical Services.

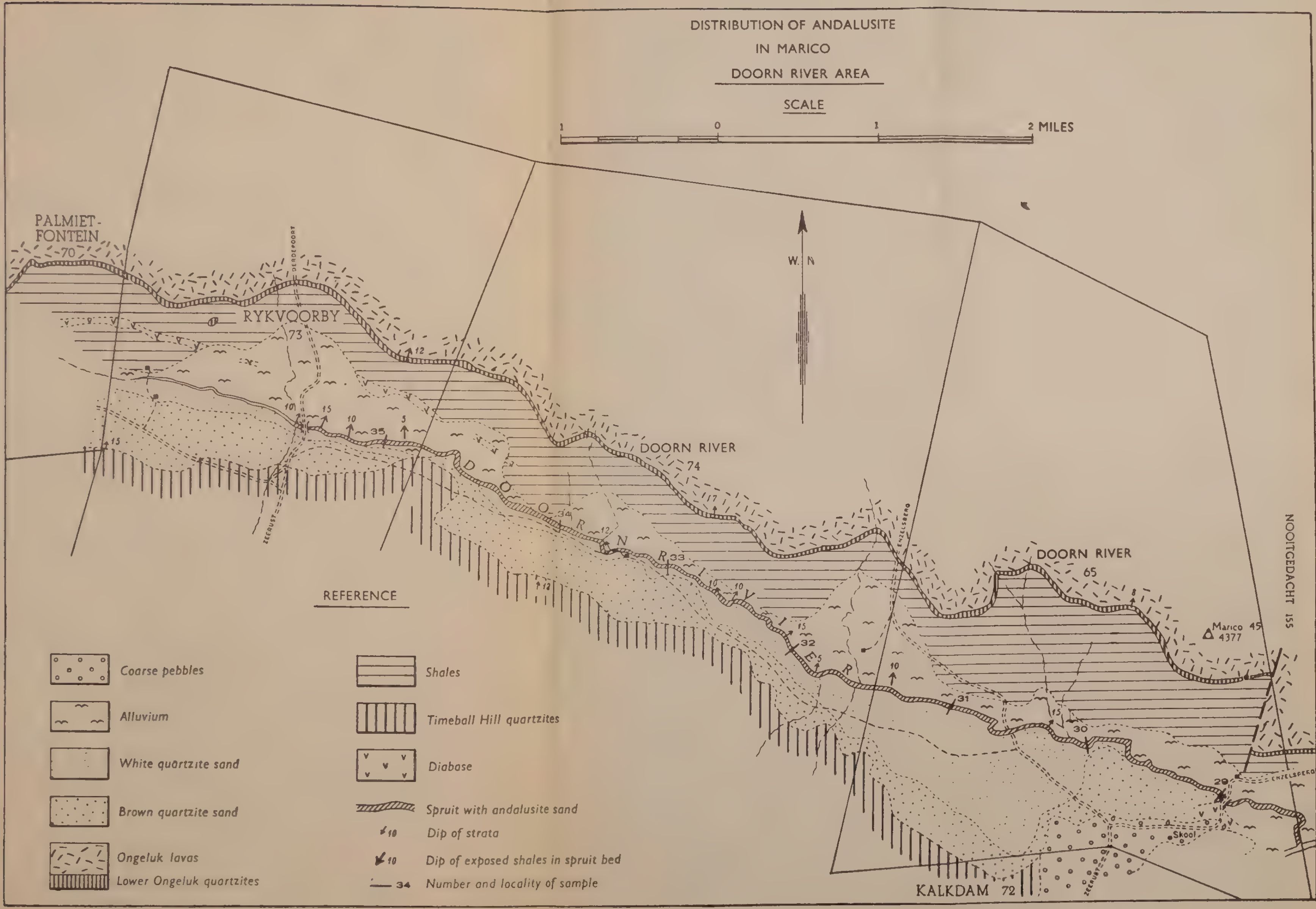

DISTRIBUTION OF ANDALUSITE
IN MARICO
DOORN RIVER AREA
SCALE
1 0 1 2 MILES
W. N
PALMIET-
FONTEIN
70
RYKVOORBY
73
DOORN RIVER
74
DOORN RIVER
65
NOOITGEDACHT 155
KALKDAM 72
Marico 45
4377
Skool
DERDEPOORT
ZEERUST
ENZELSBERG
D O O R N R I V I E R
REFERENCE
Coarse pebbles
Alluvium
White quartzite sand
Brown quartzite sand
Ongeluk lavas
Lower Ongeluk quartzites
Shales
Timeball Hill quartzites
Diabase
Spruit with andalusite sand
Dip of strata
Dip of exposed shales in spruit bed
Number and locality of sample
34
35
33
32
31
30
29

FIG. 3.

In none of the prospecting trenches was there any difference in the andalusite content over the width of the layer. Although some of the samples contain a very high percentage of andalusite, selective sampling was not necessary. Sample 22 contains as much as 76 per cent. of recoverable andalusite.

F. CONCLUSIONS

All the andalusite deposits are situated near the railway from Johannesburg to Mafeking, and access to the different spruits presents no insurmountable difficulties.

A conservative estimate of the ore reserves in all the spruits indicates a tonnage of 800,000 tons, of which at least 50 per cent. is pure andalusite.

Several attempts have been made to export andalusite from Marico but met with no noticeable success. The material is, however, quite suitable for the making of fire-bricks, and certain overseas firms have shown some interest, but it is doubtful whether material from Marico will be able to compete with other aluminous refractories. The local demand may, however, increase as heavy industries expand.

The specific gravity, durability and hardness of andalusite render it suitable for concentration by natural processes. Hardly any changes in it are produced by exposure to the atmosphere, and it is left intact when the parent shale is weathered away. The andalusite-bearing shales in the Marico district are very thick, and whenever a sufficient amount of rain falls, andalusite will be washed down to the spruits.

Consolidated Rand Brick, Pottery and Lime Co., Ltd., Olifantsfontein, Transvaal, and Harrisons Refractory and Abrasive Minerals, Pty., Ltd., Exploration Buildings, Johannesburg, are producers of andalusite (5).

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(5) .... *Quart. inform. Circ. Dep. Min. S. Afr.*, 1946, *pp.* 15–16.

Table Showing Content of Andalusite Sand from the Marico District

Deposit	Sample number	Screening						Assays of concentrates					Extent of deposit					Recoverable andalusite (tons)
		Mesh	Weight of fraction (grams)	Weight of andalusite portion (grams)	Percentage andalusite in fraction	Percentage recoverable andalusite in 100-gram sample		SiO_2 (per cent.)	TiO_2 (per cent.)	Al_2O_3 (per cent.)	Fe_2O_3 (per cent.)	Percentage theoretical andalusite (Al_2SiO_5)	Length (feet)	Width (feet)	Depth (feet)	Volume (cub. feet)	Tonnage sand (20 cubic feet per ton)	
						In fraction	Average											
Kleinfontein spruit.......							40						20,000	15	4	1,200,000	60,000	24,000
Vaalkop spruit..........	5	− 8 + 14 + 20 + 28 + 32	22·2 18·8 13·0 5·4	18·6 17·8 11·2 4·3	84 95 86 79	52												
	6	− 8 + 14 + 20 + 28	26·4 24·3 14·5	20·9 19·1 12·7	79 79 88	53												
	7	− 8 + 14 + 20 + 28	25·0 19·9 12·8	19·0 17·0 10·6	73 86 83	47												
	8	− 8 + 14 + 20 + 28	20·3 23·4 17·6	17·3 18·6 14·6	85 79 82	51												
	9	− 8 + 14 + 20 + 28	26·9 25·6 16·5	21·2 23·6 12·1	79 92 73	57												
	10	− 8 + 14 + 20 + 28 + 32	28·2 21·2 13·1 5·1	21·8 18·2 11·1 3·9	77 86 84 77	55												
	11	− 8 + 14 + 20 + 28 + 32	20·9 16·0 10·1 5·3	15·3 13·1 8·5 3·6	73 82 84 68	41												
	12	− 8 + 14 + 20 + 28	26·9 20·1 13·1	19·5 16·4 10·4	72 80 79	46		44·4	0·4	52·9 99·9	2·2	+ 80						
	13	− 8 + 14 + 20 + 28	25·4 25·7 15·5	19·6 20·3 11·8	77 79 76	52												
	14	− 8 + 14 + 20 + 28	15·2 20·7 18·7	11·6 17·7 16·5	76 86 88	46												
	15	− 8 + 14 + 20 + 28	27·1 24·0 13·5	21·9 19·6 11·9	79 82 87	53												
	16	− 8 + 14 + 20 + 28 + 32	8·3 13·6 14·8 17·8	5·4 11·5 12·9 11·4	65 85 86 64	41		41·3	0·5	55·1 99·5	2·6	+ 80						
	17	− 8 + 14 + 20 + 28 + 32 + 60	8·2 12·3 14·8 7·0 25·7	4·8 10·1 12·4 6·3 18·6	58 82 84 90 72	52	49						29,500	25·3	2·0	1,500,000	75,000	36,750
Wilgeboom spruit above the confluence with the Vaalkop spruit	24	− 8 + 14 + 20 + 28	33·1 22·9 9·0	22·2 19·1 5·5	67 83 60	47												
	25	− 8 + 14 + 20 + 28 + 32	37·0 16·7 5·4 1·8	27·9 13·9 4·1 trace	76 85 76 —	46												
	26	− 8 + 14 + 20 + 28 + 32	26·0 20·0 9·5 3·0	19·4 17·3 7·6 2·0	73 84 80 67	46												
	27	− 8 + 14 + 20 + 28 + 32	32·8 21·7 11·1 3·4	27·2 19·1 9·3 2·6	83 88 84 75	58												
	28	− 8 + 14 + 20 + 28 + 32	— — — —	19·8 23·1 14·5 5·0	— — — —	62	52	43·4	0·4	52·9 99·3	2·6	+ 80	12,200	16·15	4·5	887,000	44,350	23,260
Wilgeboom spruit between the Vaalkop spruit and the Little Marico river	4	− 8 + 14 + 20 + 28 + 32	30·3 25·1 16·2 5·8	23·5 21·3 13·4 4·8	77 85 85 83	63		44·0	0·4	52·4 99·8	3·0	+ 80						
	18	− 8 + 14 + 20 + 28 + 32	18·4 22·2 15·9 6·7	13·2 18·4 12·4 4·8	72 83 78 71	50												
	19	− 8 + 14 + 20 + 28 + 32	28·5 23·3 14·6 5·4	22·4 19·7 12·0 4·0	79 84 80 94	58												
	20	− 8 + 14 + 20 + 28 + 32	16·4 19·1 15·8 8·4	12·6 16·4 13·2 6·0	77 86 83 71	48		44·6	0·4	52·1 99·8	2·7	+ 80						
	21	− 8 + 14 + 20 + 28 + 32	29·3 34·4 19·0 4·8	24·4 30·8 17·2 3·9	83 89 90 81	76												
	22	− 8 + 14 + 20 + 28	19·5 20·3 14·8	14·7 16·3 12·6	75 80 85	44												
	23	− 8 + 14 + 20 + 28 + 32	24·9 23·9 16·1 6·1	19·3 20·1 14·6 4·4	78 84 91 72	58	56·7						11,050	53·15	8·0	4,679,300	233,900	132,206
Little Marico river between the Wilgeboom spruit and the irrigation canal	36	− 8 + 14 + 20 + 28 + 32	23·6 27·2 19·2 9·3	20·1 21·8 9·7 2·7	85 80 51 29	54	54						12,000	35·0	7·0	2,940,000	147,000	79,380
Little Marico river below the irrigation canal up to the Great Marico river							+ 54						13,400	35·0	5·0	2,345,000	117,350	58,620
Wonderfontein spruit.....	1	− 8 + 14 + 20 + 28 + 32	25·4 13·8 7·4 3·2	17·5 11·2 5·7 2·0	65 80 75 62	36		42·0	0·3	54·2 99·4	2·9	+ 80						
	2	− 8 + 14 + 20 + 28 + 32	28·5 18·8 9·5 4·4	21·7 15·1 6·6 2·3	76 80 67 55	46												
	3	− 8 + 14 + 20 + 28 + 32	27·0 19·3 11·2 4·3	21·2 16·4 8·7 —	79 85 78 —	46	43						5,200	25·5	12·25	1,623,900	81,190	34,900
Doorn river.............	29	− 8 + 14 + 20 + 28 + 32	17·6 14·0 10·0 4·4	11·6 10·5 6·5 1·9	66 75 65 43	31												
	30	− 8 + 14 + 20 + 28 + 32	5·7 9·1 11·7 7·9	3·8 6·4 6·9 3·0	67 70 75 38	20												
	31	− 8 + 14 + 20 + 28 + 32	11·5 15·5 16·5 7·8	7·8 11·2 10·2 4·2	68 72 62 55	33												
	32	− 8 + 14 + 20 + 28 + 32	10·5 14·5 17·3 10·5	8·4 11·7 11·8 4·3	79 81 54 42	36												
	33	− 8 + 14 + 20 + 28 + 32	9·1 13·8 15·9 11·6	5·5 7·3 11·2 5·6	61 53 70 49	30												
	34	− 8 + 14 + 20 + 28 + 32	9·1 12·3 15·5 9·5	5·6 8·5 8·6 5·5	61 69 56 58	28												
	35	− 8 + 14 + 20 + 28 + 32	10·8 13·0 12·2 7·3	4·8 6·7 7·4 2·9	44 52 61 40	22	28						29,200	26·5	2·5	1,934,500	96,700	27,070
															Totals..	17,109,700	855,390	416,600